

March 18, 1897.

The LORD LISTER, F.R.C.S., D.C.L., President, in the Chair.

A List of the Presents received was laid on the table, and thanks ordered for them.

The following Papers were read:—

- I. "The Cultural Evolution of *Cyclamen latifolium* (Sibth.)." By W. T. THISELTON DYER, C.M.G., C.I.E., F.R.S.
- II. "On the Conditions which render Absolute the Readings of the Mercurial Thermometer." By S. A. SWORN. Communicated by Professor CLIFTON, F.R.S.
- III. "Experiments on the Flame Spectrum of Carbon Monoxide." By W. N. HARTLEY, F.R.S., Royal College of Science, Dublin.

"The Cultural Evolution of *Cyclamen latifolium* (Sibth.)." By W. T. THISELTON DYER, C.M.G., C.I.E., F.R.S. Received and read March 18, 1897.

On the occasion of the discussion on "Variation in Plants and Animals," which took place on February 25, 1895, it occurred to me that it might be useful to give an illustration of the amount of change which had been effected in a plant by continuous selection under cultivation in a comparatively short time. I, therefore, placed upon the table an example of the wild and of the cultivated form of the garden "cineraria" (*C. cruenta*).

The choice of this species was purely accidental. It was, however, violently impugned. It was contended that the garden cineraria was not the result of the development of a single species, but that it was of multiple origin, and the result of the intercrossing of several. It was further contended that its change from the wild form had not been gradual, but by discontinuous steps or "sports." Neither contention seemed to me well founded. But I admit that, owing to the lapse of time since the so-called "improvement" of the cineraria commenced, it is impossible to give formal proof that the process has been what I described. Mr. Darwin met with the same difficulty. He remarks: "We know hardly anything about the origin or history

of any of our domestic breeds.”* As is, however, well known, he regarded them as the result of accumulation by selection of successive slight variations. But he also tells us that “the chance will be infinitely small of any record having been preserved of such slow, varying, and insensible changes.”

It seemed to me important, therefore, to obtain the history of some cultivated plant which would not be open to the objections urged in the case of the *cineraria*.

After some consideration I selected the plant known in gardens as *Cyclamen persicum*. Owing to the kindness of the skilful horticulturists who have worked upon it, I am able to place on record a nearly complete history of the changes it has undergone.

The genus *Cyclamen* belongs to the small order *Primulaceæ*, which in its affinities is somewhat isolated. *Cyclamen* itself is distinguished from the rest of the tribe *Lysimachieæ*, to which it belongs, by the reflexed segments of the corolla.

Cyclamen persicum, Mill., is a name given by gardeners to a form slightly modified by cultivation of *C. latifolium*, Sibth., a species confined to Greece and Syria. There is a good figure of the type in Sibthorp's ‘*Flora Græca*’ (t. 185). It has pink flowers, with a ring of darker colour at the throat. The species is said to have been first cultivated in Europe at Lille in 1731,† having been introduced from Persia. There must have been some error as to its origin, for Boissier points out that the species is not found in that country.‡ In all probability it was obtained from Syria. The Lille plant ultimately went to Ghent, and it has been asserted that all the cultivated forms in existence are descendants from this one individual. The assertion cannot be proved, but is not improbable. It is known to have been a variety with white flowers. As will be shown, the forms now in cultivation have been derived from a white-flowered one, which in turn might well have been derived from the Lille plant.

Such a modified form was, in fact, that described by Miller, in 1768, in the eighth edition of his ‘*Gardener's Dictionary*,’ under the name of *Cyclamen persicum*. He describes the flowers as “pure white with a bright purple bottom.” It was figured in the ‘*Botanical Magazine*’ in 1787 (t. 44), and it has come down little altered to our own day. In 1875 Boissier describes it as “*forma hortensis a me nunquam spontanea visa*.” It still exists in cultivation, and is the (old) “crimson and white” of Messrs. Sutton. It seems always to have been popular in cultivation on account of its agreeable fragrance. This confirms the Syrian origin of the original stock, for

* ‘*Origin*,’ 6th ed., p. 29.

† ‘*La Semaine Horticole*,’ 1897, p. 23.

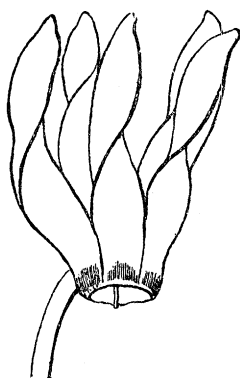
‡ ‘*Flora Orientalis*,’ vol. 4, p. 12.

a white-flowered form "is found in Palestine which is very fragrant."*

Early in the century some colour variations were in cultivation. Several as well as the typical *C. persicum* were figured in the 'Flore des Serres' in 1877 (t. 2345). These record the amount of change from the wild type which had been accomplished in a century and a half. One striking seminal sport (*C. persicum*, var. *laciniatum*) is figured in the 'Botanical Register' in 1827 (t. 1095). It is remarkable for spreading corolla-segments broader than usual, and cut at the edges. It does not appear to have been perpetuated, but in some degree it anticipated some of the remarkable modern developments.

I am informed by Mr. James Martin, the accomplished propagator of Messrs. Sutton, that the recent remarkable development of the cyclamen began about 1860, and, at any rate in their hands, started with the old "crimson and white." It will be seen from the accompanying figures how little this differs from the wild type. Fig. 1

FIG. 1.

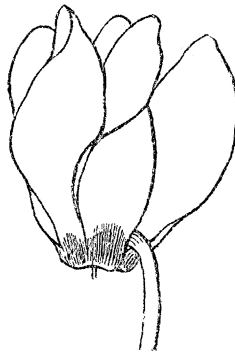


represents a flower of the latter from a plant imported by Messrs. Sutton from Syria after six years of cultivation. It is not appreciably altered. Fig. 2 represents a flower of their "crimson and white;" it only differs from the wild type in having shorter, broader, and less twisted corolla segments.

In considering the progress which has been made since 1860 under the skilful hands of Mr. Martin and others, it is important to bear in mind that there is no question of hybridity. *Cyclamen latifolium* has resisted every attempt to cross it with any other species. We are dealing then with the evolution under artificial

* 'Roy. Hort. Soc. Journ.' N. S., vol. 13, p. 163.

FIG. 2.



conditions of a single species. Further, in the following statement, I have confined myself to the result of continued self-fertilisation, and have not thought it necessary to investigate the results of crossing races which have assumed characters more or less distinct.

Size.

Mr. Martin strongly insists on the principle laid down by Mr. Darwin from De Vilmorin, that "the first step is to get the plant to vary in any manner whatever."* As Mr. Martin puts it, "the breeder must work with nature." It is his practice to seize the smallest deviation, even so small an indication as the slightest difference in a cotyledon of a germinating seed. The first direction of work would, however, for commercial purposes, be to develop the size of the corolla. Figs. 3 and 4 show two stages which have been reached by progressive selection from "crimson and white." Messrs. Sutton have sent me photographs of the largest flowers hitherto produced by them. Fig. 5 is copied from one of these. The vertical depth is 3 in. This is more than double that of the form with which they started; the increase in breadth of the segments is at least six times. This represents the continuous work of forty years. As the work was not done for a scientific purpose, the whole of the progressive steps have not been preserved or recorded. Only saleable stages have survived. But Mr. Martin emphatically denies that they have been attained by other than progressive selection or that they have been reached by leaps and bounds. In developing any particular character it is, to use his own words, always done by a "ladder," *i.e.*, continuous self-fertilisa-

* 'Animals and Plants under Domestication,' vol. 2, p. 262.

FIG. 3.

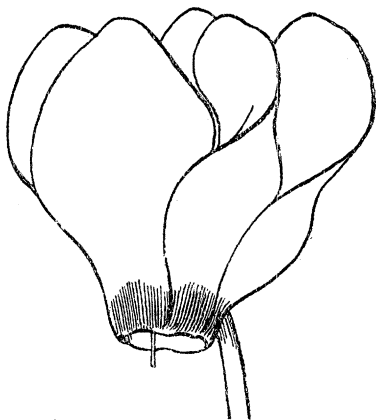
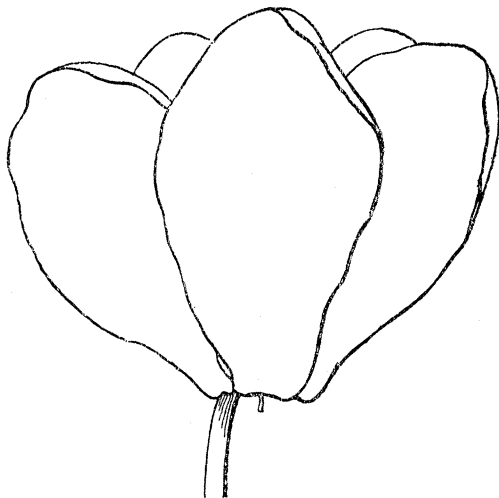


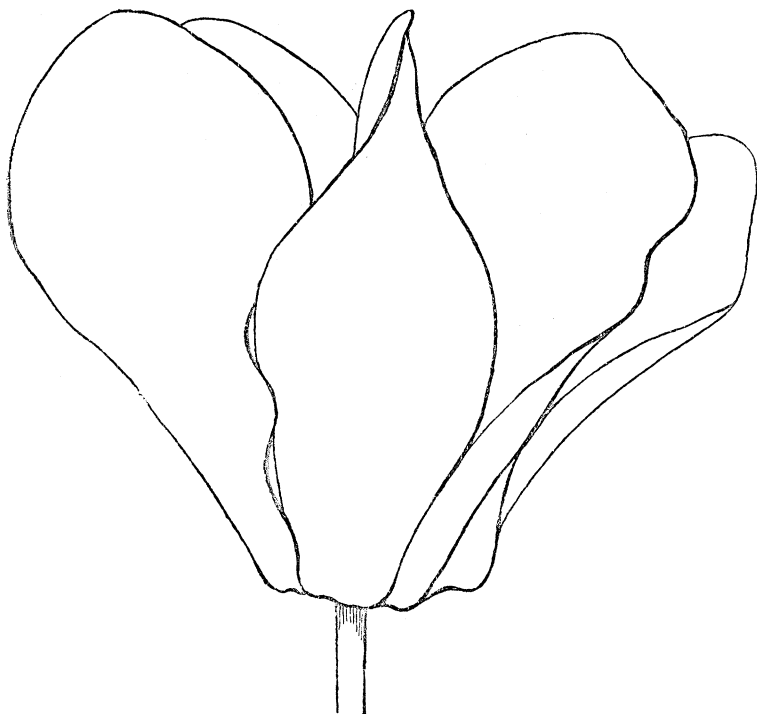
FIG. 4.



tion and selection. The stage shown in fig. 3 owes its preservation to its having retained fragrance. Beyond this stage fragrance has been lost.

An interesting question is whether there is any limit to the extent to which an organ can be developed, and if so, what? It is to be hoped that Mr. Martin will continue his work in this direction and strive, if only as a matter of scientific interest, to increase the size of the corolla to the maximum possible. The only check will probably be found to be the general balance of nutrition.

FIG. 5.

*Spreading.*

I was much struck to find amongst a magnificent series of specimens, kindly sent me by Messrs. Sutton, forms with the segments of the corolla spreading instead of reflexed (fig. 6). I have received even more striking examples from Messrs. Hugh Low. This is remarkable because, as I have already pointed out, the latter is a distinctive generic character in *Cyclamen*. Although the alteration in the appearance of the flower is enormous, the structural change is slight. It is merely a matter of direction of growth. It amounts, however, to the loss of a generic character and a reversion to a more generalised type. The change is therefore essentially atavistic.

I was unable to obtain from Mr. Martin any explanation of how this particular variation had come about, but he informed me that it had been of frequent occurrence. Spreading flowers had always been destroyed as departing from a desirable type. More recently, on account of their orchid-like habit, they had taken the popular fancy, and had been preserved.

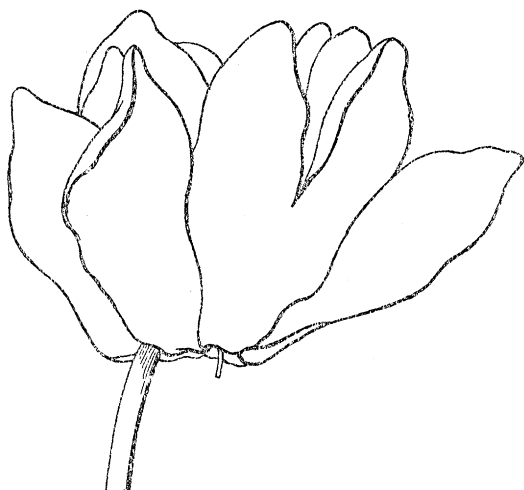
FIG. 6.



Doubling.

Even in the wild type there is a tendency to a slight multiplication of the corolla segments. Mr. Martin has worked upon this, and has produced flowers such as shown in fig. 7. He seems to think that there is no limit to which this multiplication cannot be carried practically, and hopes in time to produce "mop-headed" flowers like a chrysanthemum. The so-called doubling of flowers, as in the rose, is a teratological phenomenon, and is due to the conversion of stamens into petals. But in *Cyclamen* this is not the case. The stamens, which are normally equal in number to the corolla segments, are also multiplied. Although a quinary symmetry is general in the *Primulaceæ*, *Trientalis*, a near ally of *Cyclamen*, ordinarily exhibits a considerable range in the number of parts of the flower. Here again *Cyclamen*, under artificial conditions, shows a reversion to a more generalised type.

FIG. 7.

*Colour.*

There is evidence that seminal variation as regards colours occurred at least as early as 1820, but the modern forms with large coloured flowers, according to Mr. Martin, originated in a different way and can be traced back to the old crimson and white. That preserves the crimson ring round the throat, but is otherwise an albino. There is nothing remarkable in this. Any species in nature may produce white flowers; albinism is in effect the commonest of all variations. "Giant white" (figs. 4 and 5) is a pure albino, in which the crimson ring has been suppressed.

The modern coloured forms were obtained in the first instance by selecting forms in which the coloured ring showed a disposition to spread into the white corolla segments. The first indication would be a scarcely perceptible streak. By selection from self-fertilised plants the streak was widened into a stripe. Continuing the process, the stripes united, and a uniformly coloured flower was obtained.

The more striking colours, such as that of "Vulcan," which is a dark crimson, were, however, obtained not by progressive selection, but amongst the progeny of cross-fertilised plants.

I learn from Messrs. Hugh Low and Co. that coloured varieties, of course when self-fertilised, come true from seed. This is in accordance with a well-known principle.*

* Darwin, 'Cross and Self-fertilisation,' p. 460.

The Butterfly Form.

This has been obtained independently by several horticulturists. The segments are partially spreading, and concave on their inner surface. One of the most remarkable is that raised by M. de Langhe-Veroëne; it is represented in figs. 8 and 9. He informs me that "these are the products of the eleventh year of improvement." He adds: "I never crossed them with any other strain; I do not like

FIG. 8.



FIG. 9.



crossing races; I prefer improving them." He has kindly favoured me with the following detailed account of the mode in which the strain has been developed and improved. I quote it in his own words:—

"Les *Cyclamen Papilio* que j'ai obtenus sont issus directement des *Cyclamen persicum*, var. *giganteum*.

"Il y a environ une douzaine d'années je remarquais parmi mes semis de *Cyclamen* une plante qui attira mon attention par l'extrême beauté de son feuillage dentelé et marbré. En examinant la plante, je vis qu'elle portait une grande quantité de boutons; ceux-ci étaient de forme plus arrondie et plus courte que ne le sont généralement ceux des *Cyclamen persicum*. La plante fut mise à part; quand elle commença à fleurir, elle m'étonna par la forme bizarre de ses fleurs. Ces diverses circonstances m'engagèrent à en recueillir les graines.

"L'année suivante j'obtins quelques jeunes plantes. Au moment de leur floraison, elles purent être comparées à la plante mère.

"Les plus parfaites de ces plantes furent choisies pour servir de porte-graine, et leurs fleurs furent fécondées entre elles. L'année suivante je fus assez heureux pour constater un nouveau progrès; mes gains surpassaient leurs parents que j'avais conservés. On pouvait apercevoir, dans ces semis aux caractères persistants, le point de départ d'une race nouvelle.

"Je continuai dans cette voie; au bout de quatre ans, j'étais en possession de quelques sujets fort remarquables. Les pétales des fleurs étaient amples et plus longs; ils se redressaient comme les ailes d'un papillon qui s'apprête à prendre son vol.

"La race se caractérisa chaque année davantage.

"Encouragé par le résultat déjà obtenu, je m'occupai à rechercher la diversité des coloris. Après quatre années je ne possédais dans mes semis que des plantes à fleurs rouges; j'avais en triant les sujets pour la reproduction toujours écarté les fleurs les moins brillantes. Il s'agissait maintenant d'obtenir des fleurs à couleurs pâles. Des efforts nouveaux furent faits dans cette voie; je vis au bout de deux ans après apparaître la première fleur aux pétales blancs et à onglet rouge; dès lors les croisements se multiplièrent au point qu'après la neuvième année la perfection des formes et des coloris est telle que tous ceux qui voient mes *Cyclamen Papilio* sont unanimes à reconnaître leur mérite et leur perfection des fleurs."

In this case the basis of the new strain was found in a marked variation or "sport." The deviation from the type could not, however, have been very marked. The most remarkable feature in "Papilio" as now developed is the curled and toothed margin of the corolla segments. These peculiarities repeat characters which occur elsewhere in the order. In *Soldanella* the toothing is conspicuous; curling occurs in cultivated varieties of *Primula sinensis*. It is

interesting to observe in "Papilio" that in the primary variation there was a correlation between the toothing of the corolla segments and of the leaves.

Cresting.

The most remarkable form which has made its appearance under cultivation is that in which a plumose crest has developed on the inner surface of each corolla segment. This is shown in fig. 10,

FIG. 10.



which represents the "Bush Hill Pioneer," raised by Messrs. Hugh Low and Co. I quote the account of its development with which they have been so good as to furnish me:—

"This interesting variety was first observed in our nurseries some four years since, but how it originated we are unable to say.

"At that time, the only peculiarity about the variety was a *very slightly raised rib* running part of the way up the petals, and showing *no tendency to branch*. This was, however, considered sufficiently curious to follow up, and we seeded it with its own pollen.

"The young plants from this showed a *decided improvement*, the rib in some cases showing a *marked tendency to branch*. The best varieties (ten in number) were again fertilised with their own pollen, and the plants now being exhibited by us have resulted, although needless to say, they are among the finest obtained up to the present though *all* show a further improvement, *every flower* having a well-branched feather on the petals.

"We have this year found some colour in one plant, and we

believe we shall have no trouble in obtaining crested flowers in a variety of colours."

The corolla segments of *Cyclamen* have no mid-rib. The appearance of such a structure is a reversion to the original leaf-type. The development of a crest from a mid-rib carries reversion very far back indeed. The branching of a leaf-structure in the plane in which it is expanded is common enough; branching in a plane at right angles to this is rare. Leafy outgrowths frequently occur from the mid-rib in the cabbage.* In this case the structure of the leaf approximates to that of a stem, of which, indeed, the leaf may be regarded as a modification.

An interesting fact with regard to this singular variation is that it has appeared more than once, and independently. It first occurred in 1885, but seems afterwards to have been lost sight of.† It has also occurred in a red-flowered form in France,‡ in which case it was also perpetuated by seed.

I have not succeeded in discovering any similar structure in any primulaceous plant occurring in a wild state. Dr. Masters, however, informs me that it has been observed in cultivated forms of *Primula sinensis*. The tendency thus seems to be latent in the order, though why it should be so I am unable to explain.

Some theoretical interest appears to me to attach to the rapid development of so striking an ornament of a corolla segment. Such appendages are frequent enough in orchids, and are regarded as adaptations to cross-fertilisation by insects. Their gradual evolution might be thought to require a long period of time; but in the present case we have definite evidence that such a structure may be developed by selection with great rapidity.

Conclusion.

1. The facts which I have stated appear to me to establish the result that when once specific stability§ has been broken down in a plant, morphological changes of great variety and magnitude can be brought about in a comparatively short space of time. This appears to me to have a very important bearing on the rate of evolution. Mr. Darwin quotes Lord Kelvin as insisting "that the world at a very early period was subjected to more rapid and violent changes in its physical condition than those now occurring;" and he adds, "Such changes would have tended to induce changes at a corre-

* Masters' 'Teratology,' p. 455.

† 'Gardener's Chronicle,' 1885, p. 536.

‡ 'Revue Horticole,' 1897, pp. 98 and 130.

§ For a general discussion of the principles of variation and specific stability, see 'Nature,' vol. 51, pp. 459—461.

sponding rate in the organisms which then existed.”* That changes may be effected with considerable rapidity cannot, I think, be denied.

2. It is further, I think, abundantly proved in the present case that, though sudden variations do occur, they are, as far as we know, slight as long as self-fertilisation is adhered to. The striking results obtained by cultivators have been due to the patient accumulation by selection of gradual but continuous variation in any desired direction.

3. The size which any variable organ can reach does not appear to be governed by any principle of correlation. Large flowers are not necessarily accompanied by large leaves. Under natural conditions size is controlled by mechanical limitations and by the principle of economy. Nature cannot afford to indulge in anything unnecessary for the purpose in view.†

4. The general tendency of a plant varying freely under artificial conditions seems to be atavistic, *i.e.*, to shed adaptive modifications which have ceased to be useful, and either to revert to a more generalised type or to reproduce “characters which are already present in other members of the same group.”‡ This conclusion must, however, be accepted with caution, for we must remember that in a case like the present we are only acquainted with variations which have been preserved with a particular end in view.

5. The case of “cresting” shows that the plant still possesses the power to strike out a new line and to develop characters which would even be regarded as having specific value, as in the total change which has been effected in the form of the leaf in *Primula sinensis*. If such a race developed any degree of sterility with other races it would have satisfied Huxley’s criterion for the artificial production of a new species.

* ‘Origin,’ 6th ed., p. 286.

† See Darwin, ‘Origin,’ 6th ed., p. 117.

‡ See Darwin, ‘Origin,’ 6th ed., p. 127.